

## Severe local storms, August, 1928—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Yankton, S. Dak.	22				\$100,000	Severe thunder-storm.	Many buildings damaged.	Official U. S. Weather Bureau
Scottsbluff County, Nebr.	24	4 p. m.	6 mi.		30,000	Hail.	Beets, potatoes, and corn badly damaged; path 12 miles.	Do.
Lyman, Nebr.	24	9 p. m.	1,760		15,000	do.	Beet crop injured.	Do.
Fort Cook and Bellevue (near), Nebr.	26	4:15 p. m.	60-440		31,000	Tornado.	Buildings on 4 farms wrecked; 1 person injured; path 5 miles.	Do.
Omaha, Nebr.	26	5 p. m.	440-880		65,000	High wind.	Buildings, orchards, vineyards, and crops hurt.	Do.
Pottawattamie, Mills, Montgomery, Cass, and Adair Counties, Iowa.	26	5:30-8 p. m.		4	625,000	5 tornadoes.	Buildings wrecked; crops ruined; livestock killed.	Do.
Phoenix, Ariz.	28	6 p. m.			100,000	Rain, hail, and wind.	Many homes and business houses damaged; communication lines down.	Do.
Moline Airport, Ill.	28	2:45 a. m.			15,000	Tornado.	2 steel towers demolished.	Do.
Alpha, Mich.	28	A. m.				Thunderstorm and wind.	Buildings, trees, and grain damaged; power and telephone service interrupted.	Do.
Bessemer, Mich.	28			2		Wind.	Character of damage not reported.	Do.
Granville, Ill. (near)	29	1:30 p. m.			1,000	Tornado.	Several farm buildings damaged or demolished; trees prostrated.	Do.
Starved Rock, Ill.	29	3 p. m.	440			do.	About 100 trees uprooted or twisted off; path 4 miles.	Do.
Philadelphia, Pa.	30	6:50 p. m.		1		Severe electrical.	Numerous accidents caused by falling trees; traffic obstructed.	Do.
Rocky Ford, Colo.	31	5 p. m.	5 mi.		100,000	Hail.	Heavy crop loss, chiefly to cantaloupes.	Do.

## RIVERS AND FLOODS

By H. C. FRANKENFIELD

*Atlantic drainage.*—Heavy local rains on August 26-27 over western Massachusetts and northwestern Connecticut caused rapid rises in the lower Connecticut River and its tributary streams. An advisory warning for the former was issued accordingly and a rise of 8.9 feet occurred at Hartford, Conn., by 4 p. m. August 27. No damage occurred along the river, and was only moderate along the tributary streams. Some highways were overflowed, and there was some suspension of electric-line service.

A tropical storm prevailing at the time caused heavy rainfall from August 10 to 12 over the valley of the James River of Virginia, the amounts averaging nearly 6 inches. Stages considerably above the flood line occurred from the mouth of the Rivanna River eastward on August 11 and 12 followed by a rapid decline.

Growing crops, principally corn, were damaged and in some lowlands washed out. On August 16, another heavy rainfall, ranging from 1 to 4 inches caused a second and greater rise on account of the saturated condition of the soil and on the morning of August 17 warnings were issued. There were no floods from Lynchburg, Va., westward, but to the eastward the crest stages were from 7 to nearly 9 feet above the flood stages. Much portable property, including livestock, was removed to places of safety. Reported losses were \$104,000 of which \$40,000 were in crops, and two men were reported drowned. Value of property saved through warnings, \$32,000.

Under the influence of the same general rain conditions above mentioned floods occurred in the Roanoke river and the rivers of central and eastern North Carolina generally. The Roanoke River at Randolph, Va., reached a stage of 31.6 feet at 4 p. m., August 13, and a stage of 31.2 feet at 1 p. m., August 18, flood stage being at 21 feet. The only higher stage of record was 34 feet at 10 p. m., December 30, 1901 (U. S. G. S.).

Therises in the Neuse, Tar, and Cape Fear Rivers were not of much consequence, except in the lower Cape Fear River. In this section Elizabethtown, N. C., reported a 4-day rise with a crest of 26 feet, 4 feet above the flood stage, on August 9. A third rise in the lower river followed a heavy 1-day rain and the river at Elizabethtown was above the flood stage of 22 feet from the evening of August 23 until the early morning of August 26. The usual warnings

were issued for all rises. Damage and loss as reported amounted to \$300,000, of which \$250,000 was in crops. Reported value of property saved through warnings, \$175,000.

From the same conditions of heavy rains, floods also occurred throughout the State of South Carolina. They were not severe over the drainage area of the Pee Dee River, but throughout the Santee system and along the Savannah River they were disastrous.

The floods in the Pee Dee River system were not severe, although along the extreme lower reaches of the Pee Dee River the crests were considerably above the flood stages. Reported losses were only \$12,000, while the reported value of property saved through the warnings was \$101,000.

Numerous warnings for these floods were disseminated at the proper time, and ample opportunity was afforded for the removal of livestock and portable property in general. In the Santee River there was only a single flood, with, however, a brief pause on August 18, but above the junction of the Wateree and Santee Rivers there were two, the first, however, much smaller than the second.

During the period from August 10 to 18, the average rainfall over the Santee Basin from the two tropical storms was as follows: Coastal plain, 4.10 inches; central counties, 7.10 inches; and Piedmont section, 11.29 inches; the apex covering Spartanburg and Greenville Counties. The floods resulting from the first rain period, August 10-11, did not extend to the Catawba-Wateree Basins, and were only moderate in the Saluda area, while in the Broad and Congaree Basins they were severe with crest stages from 9.5 to 13.5 feet above the flood line. The Santee flood set in during August 12.

The second floods from the additional heavy rains of August 15-16 were remarkable for the general high stages attained and for their destructiveness. On account of the breaking of a power dam across Broad River at Lockhart, about 30 miles above, the water at Blairs reached a stage at 2 p. m. August 17 of 40 feet, 25 feet above the flood stage and 3.1 feet above the previous high-water record of July 16, 1916. The Congaree River at Columbia reached 33.5 feet, or 18.5 feet above the flood stage at 2:30 a. m. August 18. This was 2.3 feet below the high-water mark of August 27, 1908, but it was stated that in 1908 the flow was somewhat retarded by the lower works of the old highway bridge, while in 1928 there was a freer flow beneath the new bridge. Warnings of both floods were timely and

accurate. At times, especially following the failure of the dam at Lockhart, when communication was interrupted, the absence of reports complicated the forecasting problem somewhat but the results were entirely satisfactory. During the flood there were about 4,000 telephone calls for information made upon the Columbia office of the Weather Bureau.

The total losses as reported were \$2,423,213; miscellaneous, \$1,405,534; crops \$937,700; livestock and other movable property, \$25,759; and suspension of business \$54,220. Reported value of movable property saved through the warnings, \$361,525.

On August 17 at 9 p. m. the Savannah River at Augusta, Ga., reached a stage of 40.4 feet, the highest stage of record. The actual discharge at this stage was only 196,000 second-feet, whereas on August 27, 1908, with a stage of 38.8 feet, or 1.6 feet less, the discharge was 325,000 feet. On March 16, 1912, with a stage of 36.8 feet, the discharge was 215,000 feet.

The flood was the first of great magnitude since the completion of the Augusta protective levee in 1913, and afforded the first opportunity to obtain data regarding the action of the river within its restricted channel, which is narrowed both by the levee on the Augusta side and by the Hamburg Road on the South Carolina side so that the waters can not spread out again until they have passed the Charleston and South Carolina bridge about 4 miles downstream. The problem is under investigation by a group of engineers, and their conclusions are awaited with interest.

At and above Augusta the loss and damage were not great, possibly between \$50,000 and \$75,000. About 300 negroes in Hamburg, S. C., were forced to abandon their homes temporarily. In the swamps and lowlands below Augusta, on both sides of the river, the losses in crops, livestock, farm property, etc., were at least \$1,000,000.

Warnings were issued as soon as required and the estimated value of savings resulting therefrom is \$1,000,000. Owing to the uncertainty as to the effect of the new levees upon the stages of the river at Augusta, the estimate of the crest stage was somewhat conjectural. However, the warnings called for a very high stage.

The floods in the Altamaha River system of Georgia were serious, and during the second rise the Oconee River at Milledgeville reached a stage of 41.1 feet on August 16, 19.1 feet above the flood stage, and 4.4 feet above the previous high-water record of January 19, 1925.

The first rise began on August 10, when the tropical storm was central over southwest Georgia and the average rainfall for August 10 and 11 was nearly 4 inches, of which by far the greater portion fell over the central and lower portions of the damage area. At Macon on the Ocmulgee River 7.99 inches fell during the 24 hours ending at 8 a. m., August 11, and at Milledgeville on the Oconee River 5.66 inches fell during the same period. Over the Altamaha drainage below Lumber City the fall was much less. The response in the rivers was, of course, immediate, with a 24-hour rise of 25.7 feet at Milledgeville by 8 a. m., August 11, followed by a rapid fall to 14.1 feet by 8 a. m., August 14, by which time a second tropical disturbance had brought another very heavy rain with an average fall on August 14-15 of about 6 inches over the Oconee and nearly 5 inches over the Ocmulgee drainage. As before, the fall over the Altamaha basin proper was much less, a very fortunate circumstance, as an equivalent fall might easily have caused a repetition of the disaster of January, 1925.

During the second rise the Oconee River at Milledgeville reached its record stage of 41.1 feet on August 16, a rise of 27 feet in 2 days. At Dublin there was virtually but one rise with a crest of 27.9 feet, or 5.9 feet above the flood stage, on August 19.

The first Ocmulgee River rise was not important, and there were no flood stages reached except on August 11 at Macon, where there was a crest of 20.9 feet, or 2.9 feet above the flood stage, at 6 p. m. The second rise was more pronounced, although flood stages were not greatly exceeded except along the lower reaches where the average excess was between 5 and 6 feet.

The Altamaha flood was also limited to a single rise, and was quite pronounced over the upper and lower sections, although only moderate between as indicated by the crest of 11 feet at Doctortown. At Charlotte, above, the crest of 26.2 feet on August 22 was 11.2 feet above the flood stage, and at Everett City, below, the crest of 15 feet on August 27 and 28 was 5 feet above the flood stage.

On account of low banks the overflow water covered wide areas, such as 1 mile at Abbeville and 2 miles at Lumber City, both from the Ocmulgee River, 5 to 6 miles at Toomsboro and 1 to 2 miles at Mount Vernon from the Oconee River and 5 to 6 miles at Jesup and 8 miles at Gardi from the Altamaha River.

Warnings for the floods were issued promptly and given wide distribution.

Very incomplete reports indicated losses and damage to the amount of \$532,275, of which \$164,350, was in buildings, highways, etc., \$25,175 in livestock and other movable property, \$192,150 in crops and \$150,600 on account of enforced suspension of business. The reported value of property saved through the warnings was \$325,450.

There was but a single rise in the rivers of the Appalachian system of the South. It was moderate, was forecast at the proper time and no damage was reported. The only flood stage occurred in the Flint River at Albany, Ga.

#### MISSISSIPPI DRAINAGE

*Ohio Basin.*—The heavy mid-month rains also caused severe floods in the French Broad River of North Carolina and Tennessee, especially at Asheville, N. C., and adjacent sections. The floods were of the destructive character incident to mountainous regions, and the damage probably amounted to several hundred thousands of dollars. There was also much crop damage. At Asheville the crest stage of 12 feet at 11 a. m. August 16 was 8 feet above the flood stage and the highest stage since the memorable flood of July, 1916.

*Missouri Basin.*—Heavy rains during the closing days of July and the early days of August were followed by extensive overflows in the Smoky Hill, Solomon, and Saline Basins of Kansas. In addition to enormous damage to crops, bridges, State roads and railroads suffered greatly. The greatest damage was experienced at Salina, where the crest of the Saline River flood on August 9 was only 21½ inches lower than that of the great flood of 1903. In the eastern portion of the city 48 blocks were flooded, in some places to a depth of several feet and the overflow continued for several days.

Losses in the Solomon Basin were estimated at \$1,349,000, of which \$999,000 was in crops, \$25,000 in livestock, \$245,000 in bridges and highways and \$80,000 on account of suspension of business. In the Smoky Hill and Saline Basins the estimated damage was \$1,477,000, of which \$1,081,000 was in crops, \$41,000

in livestock, \$310,000 in bridges and highways and \$45,000 on account of suspension of business. The total loss reported was \$2,826,000. Railroad losses are not included in this total. Warnings were issued when the first heavy rains were reported, and repeated daily until the floods subsided. No report was made as to savings made through the warning service. A minor flood in the Grand River of Missouri between August 4 and 6 passed off without damage. The usual warnings were issued.

**Arkansas drainage.**—Heavy local rains on August 3–4 caused a moderate flood in the Arkansas River between Webbers Falls, Okla., and Fort Smith, Ark., and a decided rise below the latter point. There was also a moderate flood in the lower Neosho River of Oklahoma. Warnings were timely and only \$6,000 damage was reported, with savings through the warnings of an equal amount.

At least once in every summer torrential rains cause destructive overflows of small streams within a comparatively limited area, and usually the resulting damage is proportionately greater than that attending floods in large rivers.

Thus it happened on August 26 and 27 over the Catskill Mountains of New York and the district to the south-eastward and southward. The rains were followed immediately by extensive overflows of the streams in the district, and especially of Rondout Creek, the waters from which were responsible for the loss of three lives and an enormous amount of damage, probably as much as \$2,000,000.

There is, of course, no river service in this section, and definite information was not available.

#### THE FLOODS OF JULY, 1928, IN THE MISSISSIPPI AND ATCHAFALAYA RIVERS

These floods resulted from a sustained rise in the two rivers that began near the middle of June and culminated after the middle of July. The stages reached were the highest of the present year, and marked the latest recorded dates for annual maximum stages as well as the highest stages at such late dates. Even higher stages would have resulted had it not been for the large reduction from evaporation during the summer season, especially the hot and dry weather of the first decade of July.

While the floods were not more than moderate so far as stages were concerned, there was probably considerable damage due to backwater, such as occurred through the Henderson Crevasse in St. Martin Parish, La.

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC DRAINAGE					
James River:	<i>Feet</i>			<i>Feet</i>	
Columbia, Va.-----	18	12	12	26.4	12.
		17	19	28.8	17.
Richmond, Va.-----	10	12	13	16.6	13.
		18	19	17.0	18.
Roanoke River:					
Randolph, Va.-----	21	12	15	31.6	13.
		17	20	31.2	18.
Weldon, N. C.-----	30	13	22	44.8	15.
Dan River:					
Danville, Va.-----	8	12	13	12.7	12.
		17	18	10.2	18.
Clarksville, Va.-----	12	13	14	15.2	14.
		19	20	14.5	19.
Neuse River: Smithfield, N. C.-----	14	19	19	14.4	19.
Cape Fear River:					
Fayetteville, N. C.-----	35	18	18	36.2	18.
Elizabethtown, N. C.-----	22	18	21	27.4	19.
		23	26	26.7	25.

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC DRAINAGE—continued					
Peedee River:	<i>Feet</i>			<i>Feet</i>	
Cheraw, S. C.....	27	17	20	35.3	18.
Mars Bluff, S. C.....	17	15	29	22.7	23.
Santee River:					
Rimini, S. C.....	12	13	(1)	30.4	21.
Ferguson, S. C.....	12	14	(1)	20.6	22.
Catawba River:					
Mount Holly, N. C.....	15	16	17	18.2	17.
Catawba, S. C.....	12	15	18	26.0	17.
Wateree River:					
Camden, S. C.....	24	17	20	35.0	18.
Malta, S. C.....	16	20	20	16.4	20.
Congaree River: Columbia, S. C.....	15	11	14	24.6	13.
		16	20	33.5	18.
Broad River: Blairs, S. C.....	15	11	14	28.5	13.
		16	20	40.0	17.
Saluda River:					
Pelzer, S. C.....	7	11	11	7.0	11.
		15	20	18.0	17.
Chappels, S. C.....	14	11	22	29.1	17.
Savannah River:					
Calhoun Falls, S. C.....	6	6	17	10.5	17.
Augusta, Ga.....	32	17	19	40.4	17.
Broad River: Carlton, Ga.....	11	15	17	20.0	16.
Altamaha River:					
Charlotte, Ga.....	15	15	Sept. 1	26.2	22.
Doctortown, Ga.....	10	22	29	11.0	25.
Everett City, Ga.....	10	19	(1)	15.0	27–28.
Oconee River:					
Milledgeville, Ga.....	22	11	12	33.4	11.
		15	18	41.1	16.
Dublin, Ga.....	22	14	22	27.9	19.
Ocmulgee River:					
Macon, Ga.....	18	11	11	20.7	11.
		15	16	23.0	16.
Hawkinsville, Ga.....	29	19	19	29.1	19.
Abbeville, Ga.....	11	15	28	16.8	17–18.
Lumber City, Ga.....	15	18	28	20.3	22.
EAST GULF DRAINAGE					
Flint River: Albany, Ga.....	20	17	19	20.1	17.
		21	22	20.5	22.
MISSISSIPPI DRAINAGE					
Ohio Basin					
Kanawha-New River:					
Radford, Va.....	14	16	17	15.0	16.
Glenlyn, Va.....	11	17	17	11.5	17.
French Broad River:					
Asheville, N. C.....	4	15	19	12.0	16.
Marshall, N. C.....	10	16	18	14.6	16.
Dandridge, Tenn.....	12	17	17	17.2	17.
Big Pigeon River: Newport, Tenn.....	6	16	16	12.4	16.
Nolichucky River: Embreeville, Tenn.....	10	16	16	13.8	16.
Missouri Basin					
Smoky Hill River:					
Mentor, Kans.....	22	3	9	25.3	4 and 8.
Solomon, Kans.....	24	4	13	28.0	10.
Abilene, Kans.....	22			24.3	
Solomon River:					
Beloit, Kans.....	18	(2)	7	28.8	2.
Niles, Kans.....	26			27.5	9.
Saline River: Tescott, Kans.....	27			30.2	4 and 7.
Grand River: Chillicothe, Mo.....	18	5	6	19.8	5.
Arkansas Basin					
Arkansas River: Webbers Falls, Okla.....	23	6	6	23.6	6.
Neosho River: Fort Gibson, Okla.....	22	5	6	24.5	6.

<sup>1</sup> Continued at end of month.

<sup>2</sup> Continued from last month.